

Claims

1. A multi-band voltage-controlled oscillator comprising:
 - an oscillating transistor;
 - a resonant circuit coupled between a base and collector
- 5 of said oscillating transistor, said resonant circuit having an inductor and a capacitor coupled in parallel with each other;
- a buffer transistor coupled to an output of said oscillating transistor;
- 10 a first output port coupled to an output of said buffer transistor;
- a variable-capacitance diode forming said capacitor;
- a control port from which a control voltage is applied to said variable-capacitance diode;
- 15 a serial assembly having a first inductor and a second inductor coupled in series with each other for forming said inductor;
- first switching means made of a semiconductor for opening and short-circuiting both ends of said second inductor;
- 20 a negative source generator coupled to the output of said buffer transistor;
- second switching means for selectively switching between an output of said negative source generator and a positive source;
- 25 a mode switching circuit receiving an output frequency switching signal from an outside; and
- a package including said oscillating transistor, buffer transistor, negative source generator circuit, and mode

switching circuit integrated therein,
wherein said second switching means issues an output to control
an opening and short-circuiting operation of said first
switching means to select an oscillation output at a low
frequency band and an oscillation output of a high frequency
band released from said output port.

2. A multi-band voltage-controlled oscillator according to claim 1, wherein an oscillator including said oscillation transistor and said resonant circuit is of an unbalanced type.

3. A multi-band voltage-controlled oscillator according to claim 1, wherein an oscillator including said oscillation transistor and said resonant circuit is of a balanced type.

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4. A multi-band voltage-controlled oscillator according to claim 1, wherein said first switching means includes a diode.

5. A multi-band voltage-controlled oscillator according
20 to claim 1, wherein said first switching means includes a
transistor.

6. A multi-band voltage-controlled oscillator according to claim 1, wherein said package includes a source port from which a positive source is supplied to said second switching means is supplied.

7. A multi-band voltage-controlled oscillator comprising:
an oscillating transistor;
a resonant circuit coupled between a base and collector
of said oscillating transistor, said resonant circuit having
5 an inductor and a capacitor connected in parallel with each
other;
a buffer transistor coupled to an output of said oscillating
transistor;
a first output port coupled to an output of said buffer
10 transistor;
a variable-capacitance diode forming said capacitor
a control port from which a control voltage is applied to
said variable-capacitance diode;
a serial assembly having a first inductor and second
15 inductor coupled in series with each other for forming said
inductor;
first switching means made of semiconductors for opening
and short-circuiting both ends of said second inductor;
a negative source generator coupled to an output of said
20 buffer transistor;
second switching means for selectively switching between
an output of said negative source generator and a positive
source, and for releasing an output to control an opening and
short-circuiting operation of said first switching means to
25 select between an oscillation output at a low frequency band
and an oscillation output at a high frequency band released from
said output port;

a mode switching circuit receiving an output frequency switching signal received from an outside;

a package including said oscillating transistor, buffer transistor, negative source generator, and mode switching circuit integrated therein;

a third inductor and a fourth inductor coupled in series with each other between a collector of said buffer transistor and a source, each of said third and fourth inductors being formed with a pattern;

10 third switching means for opening and short-circuiting both ends of said fourth inductor according to an output of said second switching means,

wherein said third inductor has a length of substantially 1/4 wavelength of an output frequency of the high band, and a
15 composite pattern of said third and fourth inductors has a length of substantially 1/4 wavelength of an output frequency of the low band.

8. A multi-band voltage-controlled oscillator comprising:

20 a first oscillating transistor;

a resonant circuit coupled between a base and collector of said first oscillating transistor, said resonant circuit having an inductor and a capacitor coupled in parallel with each other;

25 a first buffer transistor coupled to an output of said first oscillating transistor;

a first output port coupled to an output of said buffer

transistor;

a variable-capacitance diode forming said capacitor;

a control port from which a control voltage is applied to
said variable-capacitance diode;

5 a serial assembly having a first inductor and second
inductor coupled in series with each other for forming said
inductor;

first switching means made of semiconductors for opening
and short-circuiting both ends of said second inductor;

10 a negative source generator coupled to an output of said
first buffer transistor;

second switching means for selectively switching between
an output of said negative source generator and a positive
source, and for releasing an output to control an opening and

15 short-circuiting operation of said first switching means to
select between an oscillation output at a low frequency band
and an oscillation output at a high frequency band released from
said first output port;

a mode switching circuit receiving an output frequency
20 switching signal from an outside;

a package including said first oscillating transistor,
first buffer transistor, negative source generator, and mode
switching circuit integrated therein;

a second oscillation transistor;

25 a parallel assembly coupled between a base and collector
of said second oscillating transistor, said parallel assembly
having an inductor and a capacitor coupled in parallel with each

other;

a second buffer transistor coupled to an output of said second oscillation transistor;

5 a second output port coupled to an output of said second buffer transistor;

a second variable-capacitance diode forming said capacitor a control port through which a control voltage is applied to said second variable-capacitance diode; and

a fifth inductor forming said inductor,

10 wherein said mode switching circuit, according to a switching signal from the outside, selects between an output from said first output port and an output from said second output port.

9. A multi-band voltage-controlled oscillator according
15 to claim 8,

wherein a ratio of the second frequency to the first frequency released from said first output port by frequency switching is not greater than 1.2, and

20 wherein a ratio of a third frequency released from said second output port to the first frequency is not smaller than 1.5.

10. A multi-band voltage-controlled oscillator according to claim 8,

25 wherein an oscillating operation of said second oscillating transistor is turned off when an output is released from said first output port, and

wherein an oscillating operation of said first oscillating transistor is turned off when an output is released from said second output port.

5 11. A multi-band voltage-controlled oscillator according
to claim 8, further comprising:

a logical adder circuit for calculating a logical addition of outputs of said first and second output ports; and

a third output port releasing an output of said logical
10 adder circuit.

12. A multi-band voltage-controlled oscillator according
to claim 10, further comprising a PLL circuit coupled to an
output of said logical adder circuit, said PLL circuit being
integrated in said package.

13. A multi-band voltage-controlled oscillator according to claim 8, comprising:

an oscillating transistor;
20 a resonant circuit coupled between a base and collector
of said oscillating transistor, said resonant circuit having
an inductor and a capacitor coupled in parallel with each other;
a buffer transistor coupled to an output of said oscillating
transistor;

25 a first output port coupled to an output of said buffer
transistor;
a variable-capacitance diode forming said capacitor;

a control port from which a control voltage is applied to said variable-capacitance diode;

a serial assembly forming said inductor; said series assembly having a first inductor and a second inductor;

5 first switching means made of a semiconductor for opening and short-circuiting both ends of said second inductor;

a negative source generator coupled to as output of said buffer transistor;

second switching means for selectively switching between
10 an output of said negative source generator and a positive source, and for releasing an output to control an opening and short-circuiting operation of said first switching means to select between an oscillation output at a low frequency band and an oscillation output at a high frequency band released from
15 said first output port;

a mode switching circuit receiving an output frequency switching signal from an outside;

20 a package including said oscillating transistor, buffer transistor, negative source generator, and mode switching circuit integrated therein;

a first capacitor coupled in series or parallel with said variable-capacitance diode; and

switching means coupled between both ends of said first capacitor,

25 wherein said switching means makes frequency sensitivities at the low band and the high band equal to each other by an opening and short-circuiting operation thereof.

14. A multi-band voltage-controlled oscillator according to claim 13, further comprising a second capacitor coupled in series with an assembly having said variable-capacitance diode
5 and first capacitor.

15. A multi-band voltage-controlled oscillator according to claim 13, a second inductor coupled between two portions into which said first inductor is divided, said portions each having
10 substantially an equal inductance.

16. A multi-band voltage-controlled oscillator according to claim 13, further comprising a capacitor coupled in parallel with said variable-capacitance diode.

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17. A multi-band voltage-controlled oscillator according to claim 13, wherein said first and second inductors are formed with patterns.

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18. A multi-band voltage-controlled oscillator according to claim 17, wherein after trimming said first inductor to adjust an output frequency at the high band, said second inductor is trimmed to adjust an output frequency at the low band.

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19. A multi-band voltage-controlled oscillator according to claim 18, further comprising:

a multi-layer substrate including an inductor formed therein; and

a grounding pattern formed at said multi-layer substrate, said grounding pattern being not formed at a portion over which
5 said inductor is formed.

20. A multi-band voltage-controlled oscillator according to claim 18, further comprising:

10 a multi-layer substrate including an inductor formed therein; and

a via-hole formed in said multi-layer substrate for exposing a portion of said inductor to a surface of said multi-layer substrate,

wherein a frequency can be adjusted by trimming said portion
15 of said inductor.

21. A multi-band voltage-controlled oscillator according to claim 13,

wherein said switching means includes switching diodes
20 being coupled between both ends of said first capacitor and being coupled between both ends of said second inductor, respectively, and

wherein a voltage generated in said package is applied to
said switching diodes to control an opening and short-
25 circuiting operation of said switching means.

22. A multi-band voltage-controlled oscillator according

to claim 13, wherein said first inductor is formed with a single inductor.